FOCUS

- a computer program for analysing systems

User manual and guide

M.R. Penno
E.G. White
July 1988

Information paper No. 9

Centre for Resource Management

Lincoln College and University of Canterbury

P.O. Box 56
Lincoln College
Canterbury
New Zealand

ISSN 0112-0875
ISBN 1-86931-035-7

The Centre for Resource Management acknowledges the financial support received from the Ministry for the Environment in the production of this publication.

Table of Contents

Introduction

FOCUS is a user-friendly computer program to generate the changing appearance of a system as an observer changes the viewing criteria. The criteria are measured by time and space scales and the range of scales is determined by the interests of the user. These interests may apply to any organised system but FOCUS has been documented in the context of resource studies. In that context, the controlling structure and functioning of a managed resource system might be compared over long and short terms and over local and regional areas. The program further permits a comparison of alternative system regimes, such as current and future management prospects, and is used to identify local subsystems. White (1988) gives an illustrated summary of theory and program application in the companion text to this manual. Some elements only are included in the manual and in the documented printout of each FOCUS analysis. Analyses are based on aspects of hierarchy theory and the user is referred to Allen and Starr (1982) and O'Neill et.al. (1986).

Program control acts through a menu of options which is re-displayed after each task has been performed. There are 11 numbered options in the main menu. To choose an option the corresponding number should be typed and the carriage return key (<RETURN>) pressed. If the number entered was not a valid input an error message will be displayed. There is a list of program errors in appendix A.

The subsequent sections discuss the 11 options.

OPTION 1

WORKSHEET GENERATOR

Before using the editor (Option 2) to input data it is necessary to define and organise the data by hand. To make this a relatively easy task worksheet blanks are provided (see appendix B). The question "How many pages of worksheet do you require ?" is displayed on the screen. At this prompt a number between 1 and 999 should be entered depending on requirements.

As elsewhere in the program the user can return to the main menu without taking any action by typing '>' and pressing <RETURN>. The created worksheets will be in a file called WORK.FRM ready for printing.

1.1 WORKSHEET ENTRY

A worksheet blank consists of two complementary sections labelled 'Component Periodicity' and 'Component Distribution'. The sections are used to organise time and space data respectively for the system of interest. Seven procedural steps are listed on the worksheet :

Steps:
> Select columns of time and space units (see footnotes).
> Nominate units for 3 time frames + 3 space frames.
> List system components.
> Encode each component across all 6 frames (1 code per frame)
> Classify components into related groupings (stems).
> Identify components belonging only to the disturbance mode.
> Review previous 4 steps, then transfer input to program FOCUS.

The first six steps are directly concerned with data specifications and data entry and are now discussed.

1.1.1 Units and measures

The worksheet lists some frequently used non-decimal measures alongside sets of decimal measures (see appendix B). Alternative sets of measures are presented in appendix C which also provides guidelines for selecting the sets appropriate to a given FOCUS project. Worksheet footnotes summarise the options and an empty column is provided for manual entry of alternative measures. A selection must be made before proceeding with data entry. Select only ONE time column and ONE space column.

1.1.2 Time frames and space frames

A project title should be assigned if computer printout is to have a header (maximum 50 characters) and the following format requests the first data entry :

PROJECT TITLE _____

Time frame units : short (S) _____ medium (M) _____ long (L) _____

The user then determines the time frames of interest ('window' durations) for the project. Three frames labelled 'short' (S), 'medium' (M) and 'long' (L) must be chosen for data analysis even if only one is of primary interest. It may be good practice here to utilise the short and the long frames to extend perceptions in either direction from the primary frame (at medium). First refer to the selected column of time measures and locate the three units of interest. Then enter these units as the S, M, and L frames.

A similar format requests the space frame data :

Space frame units : small (S) _____ medium (M) _____ large (L) _____

Three space frames are now declared in the same manner as for time frames.

1.1.3 System components

There are two crucial choices in characterising a system. The first (and foremost) is the identification of its member parts, i.e. its components. The second is the characterising of their behaviour (see 1.1.4).

In order to identify components, the user should first clarify the phenomenon or phenomena being investigated. Not all components of a system are relevant to every phenomenon that it may show. For example whereas 'nesting sites' may be relevant to the phenomenon of habitat sustainability, 'nesting interference' and not sites may be relevant to the phenomenon of recreationist impacts (further see Allen and Starr, 1982, pp 161-163). For a given phenomenon the set of components should be

distinguishable entities within the system. Note that the user should not be deterred by uncertainty here but should be satisfied by the best available listing of components, for data analysis itself may contribute to improved definition. An analysis provides a working hypothesis of system functioning based on the best insights available, but (as ever) these are subject to updating.

The name of each system component is entered in a worksheet column and assigned a component number :

```
Component No. I 1      I 2      I 3      I 4 ...
              I        I        I        I
              I        I        I        I
              I        I        I        I
```

At least the first five characters of the name should be unique (see 2.1.3) and a maximum of 50 components can be listed for the project (10 components per worksheet). The list may include components from alternative system regimes, such as current non-disturbed and future disturbed states (see 1.1.5).

1.1.4 Component behaviour

The second crucial choice is the characterising of component behaviour. Careful characterisation is re-paid by the quality of program output, but this does not mean that all (or any) behaviour can be defined with certainty. As in the identification of components (see 1.1.3), systems study can only proceed if working hypotheses are first proposed, however tentatively. White (1988) illustrates the assignment of behaviour scales in time and space.

The component periodicity section of the worksheet is used to characterise behavioural time (rows) across all components (columns) :

Behavioural Time			Time frame			I S M L I
0						
1						
:						
:						
5	x4		4	1mo	4	I I
6	x6		1wk	1.4	6	I I
7	10		1.3	2	9	I I
8	x1.3		2	3	1y	I I
9	x2		3	4	1.5	I I
10	x3		1mo	6	2	I I
11	x4		1.2	9	3	I I
12	x5		2	1y	4	I I
:						
:						
30						
31						

Each component column is divided into the three selected time frames, shown as S, M, and L (see 1.1.2), and one entry must be determined for each frame of every component. As component sequence is ultimately the basis of program analysis, unused lines are of no concern.

To determine component behaviour within the time frame, note the codes that follow and then proceed through the listed tests (in order) until a worksheet entry is made on the appropriate line, as indexed by the chosen time column.

Codes : R = Repeating (over time/space).
N = Non-repeating (over time/space).
* = Not applicable (at given time/space frame).

Tests :

1. is the component recognisable within this time frame - if not, enter an asterisk (*) against 'Not Applicable' (line 0).
2. if recognisable, does component behaviour progress by identifiable events or patterns (regular or irregular) within this time frame - if not, enter 'N' against the same units as the time frame itself.
3. if identifiable events or patterns occur, is there normally at least one full event or cycle within the extent of the time frame - if not enter 'N' against the units that define the observable frequency of the event or cycle (if events occur within events or cycles within cycles, define only the predominant behaviour; and if "ON" phases are disengaged by "OFF" phases, define events as they apply within the "ON" phase only - do not define the frequency of the ON-OFF phasing).
4. if more than one full event or cycle normally occurs, which units characterise the predominant behaviour patterns over time - enter 'R' against these units (parentheses for 3 above still apply).

Entries are similarly made in the 'Component Distribution' section of the worksheet where rows define behavioural space :

Behavioural Space			Space frame		I I S M L I
0					
1					
:					
:					
14	100	__	x4	x1.8	I I
15	x1.6	__	x6	x3	I I
16	x2	__	1000	x6	I I
17	x3	__	x1.6	10000	I I
18	x5	__	x2.5	x1.8	I I
19	x7	__	x4	x3	I I
20	1000	__	x6	x6	I I
21	x1.4	__	10000	10**5	I I
:					
:					
30					
31					

'Behavioural' space refers to the scales of spatial patterning, recognised by degrees of patchiness and including patches within patches (i.e. regions within regions). The four tests above still apply substituting 'space' for 'time'. Tests 2-4 are re-worded:

Tests:

2. if recognisable, does component distribution progress by identifiable patches or regions (regular or irregular) within this space frame - if not, enter 'N' against the same units as the space frame itself.
3. if identifiable patches or regions occur, is there normally at least one full entity or assemblage within the extent of the space frame - if not enter 'N' against the units that define the observable extent (if entities enclose entities, define only the predominant pattern; and if spatial quality confines a component's behaviour, define patterns as they apply within inclusive spaces only, say, fish within aquatic space but not in terrestrial).
4. if more than one full patch or region normally occurs, which units characterise the predominant pattern - enter 'R' against these units (parentheses for 3 above still apply).

1.1.5 Hierarchy stems and modes of analysis

An opportunity is available to identify the performance of 1-5 sub-groups of components (stems) during hierarchy analysis, and every component must be assigned a single-letter label. The column format for the label is shown below, and the full name is also determined for each label type, e.g. physical (P), social (S), economic (E).

```
                  I     I     I
Stem + Mode       I     I     I
                  I     I     I
```

The mode by which a component will be analysed is also declared for each component column. Two choices are available, coded as follows :

Modes : blank = Without disturbance
D = With disturbance

The first choice allows the component to be included in two classes of analysis if both are used. These represent alternative system regimes such as state 1 (e.g. the present, without disturbance) and state 2 (e.g. the future, with disturbance). In the first class of analysis (state 1) only the first choice components (blank mode) are analysed. The second choice components (mode = 'D') are restricted to analyses of all components (i.e. combined blank + 'D' modes.)

OPTION 2

THE EDITOR

The editor is used initially for entering components and also for making changes and additions to saved data. See 12.2 for explanation of the universal exit ('>').

2.1 NEW INPUT

If new data is to be entered then the screen will display :

Input the project title.

_____

At this prompt a suitable name for the project should be entered. This will appear on all printouts created by FOCUS.

2.1.1 Stem declarations

Components entered on the worksheet are classified into related sub-groups called stems. It is necessary to declare the stem names that have been selected and designate a single-letter label for each one. A range of 1-5 stems is allowed. Entries should be made at each prompt. For example :

Stem 1> **Biological** Label> **B**

If all stems that are to be used have been declared, 'END' is entered to indicate this. If five stems have been declared 'END' is assumed and is therefore not needed. Opportunity for correction of mistakes is given after the input of each stem and label.

2.1.2 Frame units

Frame units are now asked for. The three time frame units from the top of worksheet A ('Component Periodicity') are entered first. Each frame is declared by entering a descriptor number (range 1-31). The entry of three numbers to define the chosen time units must be in the order smallest (short frame) to largest (long frame). For example, a valid numbering sequence for time units could be :

Short **20** Medium **23** Long **26**.

Space frame units are then entered in the same manner. If an incorrect number is entered it is possible to change the input by answering 'Y' to the question "Do you want to make any changes (Y or N)?". The frame size to be changed should then be entered (i.e. S, M, or L) and the cursor will appear in the appropriate place ready for the corrected input.

2.1.3 Component input

Now that the preliminary declarations have been made the system components can be entered and component behaviour within each of the six frames can be specified from the worksheet. On the screen a component template is displayed. The component number at the top of this screen will correspond to the number on the worksheet.

The first entry in this template is the component name. For some printouts it is necessary to truncate component names and so it is helpful to make component names unique, especially in the first five characters. In cases where it is necessary to truncate, the component number will (as always) be printed as a clear reference.

The stem label is now entered. If the component was described as a member of the biological stem (see above example) the input would be a 'B'. Next the mode of analysing the component is declared. No entry is made if the component is to be included in all analyses, and a 'D' is entered if restricted to some analyses only. The two modes represent two system states, labelled for convenience 'Without disturbance' (state 1; 'blank' components only) and with disturbance (state 2; 'blank' and 'D' components). It is not essential to extend analyses to a second state.

Entry of behaviour codes can now be made. There are three codes :

N = non-repeating over time/space
R = repeating over time/space
* = not applicable at a given time/space frame

To enter behaviour codes against the chosen units, coordinates specifying the correct place on the screen are entered at the '->' prompt. Each coordinate includes two characters and a number. The first character is either 'T' (time) or 'S' (space) to indicate which half of the screen is being entered. The second character selects the time or space frame of interest from three columns, headed S (short or small), M (medium), and L (long or large).

The last part of the coordinate is the descriptor number corresponding to the behavioural time or behavioural space units. For example, when referring to the left-hand column of time and space units,

TS9 = time frame : short : 10 x2
TM21 = time frame : medium : 1000 x1.4
SS19 = space frame : small : 100 x7
SL26 = space frame : large : 10 000

After coordinates have been entered the cursor will appear at the specified screen position ready for an input of N, R, or *. The N and R codes can appear with any units except 'Not Applicable' (descriptor number 0). The '*' indicates not applicable and should only be used in the 'Not Applicable' position. After a behaviour code has been entered the cursor will return to the '->' prompt ready for more input.

It should be noted that there can be only one entry in any frame (i.e. in each of six columns). If there is a code in a column and a new code is entered in the same column the previous code is automatically deleted. This method is used to correct error entries.

To the right of each column there is a '_' marker. The set of six markers indicates those units declared as the upper observation limits for each time and space frame. Behaviour codes should not therefore be placed at screen positions lower than the marker for the given column.

When all six frames have a code entered correctly, 'END' is entered. If 'END' is entered but not all frames are filled a reminder is given to make sure that this is realised. Data input can now continue with the second component and so on. 'END' should not be entered when data entry has been completed for the final component.

To exit from the editor 'EX' is entered. The option of saving components to a file then follows and there is also an option to get a printout of the entered component data. The printout will be in a file called FOCUS.PRN, if it is created.

2.2 EDITOR COMMANDS

Descriptions of the editor thus far refer to its basic operations. Also included are a range of commands to increase flexibility. A command is entered when the '->' prompt is displayed. Possible abbreviations are indicated in brackets.

2.2.1 HELP

The HELP command provides on-line help for any of the other editor commands and some program concepts. If HELP is typed alone a list of the commands is given and a definition can be found by typing the wanted command after the 'Topic?' prompt. If a definition is not wanted, exit the HELP facility by typing '>'. If the name of a command is known its definition can be directly accessed with 'HELP <command>' after the '->' prompt. For example :

-> HELP	:	this will cause all available commands to be displayed.
-> HELP END	:	this will display the definition of END on the screen.

When asking for help on a command at least three letters of the command need to be specified.

2.2.2 COMPONENT (COMP)

It is possible that the component name may need to be changed. If COMP is typed the user is given the opportunity to re-name the component or correct a spelling.

2.2.3 STEM

The stem label can be changed to any other previously declared label by typing STEM after the prompt '->'.

2.2.4 MODE

If MODE is typed the mode of analysing a component can be changed. The default mode is state 1 'without disturbance', designated by the blank response (' '). The component mode is set to the default each time MODE is entered. To designate state 2 ('disturbed' mode) a 'D' must be typed.

2.2.5 Coordinates

Coordinates are an editor concept (not a command) and may need explanation. The 'Help' facility provides this.

2.2.6 END

This command terminates input to one component and leads on to the next.

2.2.7 EXIT (EX)

This is the command to exit from the editor back to the main menu.

2.2.8 DELETE (DEL)

It may be necessary to delete a component. The component to be deleted must be currently on the screen. When the command 'DEL' is entered, the screen will be refreshed and the mode set to 'G'. This indicates that the component has been deleted. 'G' is not a valid user input for mode. Before the component is deleted the user is given the opportunity to cancel the deletion.

Once a component has been deleted the component number is available for another component. It may be important for large data sets that deleted component numbers are re-used because the program has a limit of 50 components.

2.2.9 GET x

The screen can only display a limited sequence of time and space behaviour units at one time. This command gives the user the chance to re-display the screen in a different position. By typing GET and the descriptor number for the units of interest (eg GET 25) the screen will be re-displayed with the units of interest near the top.

2.2.10 FIND f1f2

It is possible that all six behaviour codes (see section 2.1.3) are not displayed on the screen at one time. The FIND command can be used to find out where a code is in a time or space frame. The command syntax is :

f1 = T (time) or S (space)
f2 = S, M or L .

For example :

FIND TM : this will display the medium time frame code in a position near the top of the screen.

To display the observation limits for a given frame, type MAX in front of f1f2.

For example : FIND MAXSL : this will display the observation limit for the large space frame.

2.2.11 INDEX (IND)

An index of components can be viewed by typing 'IND'. This displays the component number and name, component stem and mode. One component in the list of displayed components will have a '+' beside it. This indicates the current component to appear on the screen when the index is exited.

2.2.12 TO z

It is possible to move from one component to any other with the TO command. For example, to display component number 12 type 'TO 12'. The value of z must be a component that already has its name declared.

2.2.13 SAVE

It may be useful to save components part way through an entry session. The SAVE command is available for this and a name is assigned to the data file.

2.3 SUMMARY OF SYSTEM COMPONENT INPUT

1. Fill in worksheet.
2. Check worksheet.
3. Enter Project title.
4. Declare Stem types (maximum allowed is five).
5. Enter the time and space frame units.
6. Encode the components across all six frames.

2.4 EDITING EXISTING FILES OF COMPONENTS

The editor can be used for other than component entry. A file of components can be loaded (using Option 10) and manipulated or extended with the editor, using commands as above. However there are some differences when first entering the editor. The project title and stem labels are read from the input file and there is no provision for changing these. The first display is therefore the index of components. The user is given the

opportunity to change any of the six time and space frame units. If this is not necessary, the last component in the index will be displayed ready for any additions or editing. If subsequently a new data set is to be entered, FOCUS must be exited to clear the memory.

OPTION 3

PRINTING OBSERVATION LIMITS AND COMPONENTS

Option 3 gives a printout of input data in a form which allows easy checking of correct data entry. The first part of the printout consists of the time and space frame units. The remainder is set out in two blocks: the time units for each component and then the space units for each component. The two blocks are identical in structure, listing the component name, stem, component mode(s), behaviour code and the chosen units for each frame.

OPTION 4

PRINTING SELECTED HIERARCHIES

Option 4 prints any of the 27 possible hierarchies for a given mode of analysis (27 = 3 time frames x 3 space frames x 3 analysis perspectives). The requested options must each be entered singly. The user is first asked if the hierarchy mode is to be 'without disturbance' (state 1 components only) or with disturbance (state 2; all components). The next screen display gives the possible hierarchy options and the user is asked to enter a 'hierarchy combination'. For example :

TIME	SPACE	ANALYSIS
1. short	1. small	1. Temporal
2. medium	2. medium	2. Spatial
3. long	3. large	3. Temporal * Spatial

Please input a hierarchy combination> **122**

A hierarchy combination consists of one number from the displayed time column, one number from the space column and one number from the analysis column. To obtain a printout of a hierarchy for short time and medium space with spatial analysis the combination 122 would be entered (note, no spaces). An example of long time and small space with temporal * spatial analysis would require the combination 313.

After a suitable combination has been entered the user is given the opportunity to edit the names of the time and space frame units to appear on the printout. This means that multiple columns of units can be re-defined to print only the unit of interest. The cursor will first appear beside the TIME> prompt ready for input. If the units for time displayed on the screen are acceptable for the printout without change the <RETURN> key can be pressed and all columns of units will appear beside the prompt. If they are not acceptable the required units can be typed directly. Entry of the space units is then done in the same manner. If an entry error occurs an option is presented to change the space and/or time input after both have been entered.

The hierarchy printout is an output of each component positioned by its respective stem and level for the requested combination. If more than one stem has been defined the user is given the opportunity to choose the ordering in which stems will be printed across the page. If the displayed default order is to be printed, <RETURN> should be pressed. Otherwise a new order can be typed in. For example :

Input the order of stems across the page left to right.

The stems are : BPS

ORDER> **SPB** (note no spaces)

The hierarchy will now be printed to the file FOCUS.PRN and the user is asked if another hierarchy is required. The main menu allows that hierarchies may be printed at any time during a session. As the evidence of other analyses may help in their interpretation, it may be convenient for the user to print them at the end, or to alternate their printing with the results of 'spatial boundaries' analyses (Option 8).

OPTION 5

CALCULATION OF COMPONENT SHIFTS BETWEEN HIERARCHIES

Option 5 must be accessed prior to using Options 6-8. It uses all 27 hierarchies in pairing sequences and by comparison within each pair, calculates scores for all shifts in the levels of components. Every component in the pairing is compared in turn with every other component. **The value of this analysis (and of Options 6-8) may be only experimental, to aid hierarchy interpretation.**

As with hierarchy printouts (Option 4) the user's first choice is between modes of analysis ('without disturbance', state 1 and 'with disturbance' state 2). Each analysis is available in turn, but note that executing Option 5 in only one mode does not allow the execution of Options 6-8 in the alternative mode, or vice versa.

A score compilation option is available to print individual scores to demonstrate how component shifts are calculated. Printouts are explanatory only and so the user is asked if they are required. If requested the number of hierarchy pairings must be specified (maximum three). The user must then choose the required pairing combination. The screen display is similar to that for hierarchy printing except that now the choice is between pairs of hierarchies. The screen display will be :

TIME	SPACE	ANALYSIS
1. short	4. medium vs small	1. temporal
2. medium	5. large vs medium	2. spatial
3. long		3. temporal * spatial
4. medium vs short	1. small	1. temporal
5. long vs medium	2. medium	2. spatial
	3. large	3. temporal * spatial

Please input a hierarchy combination > **411**

The combination that is entered must again have three digits (no spaces). The first digit is the time option, the second is space and the third is the type of analysis. Of the first two digits one must be a pairing (ie M vs S or L vs M) and the other must be a single frame (ie S, M, or L). The selected combination will therefore be taken from either above the displayed central line or from below the line, but cannot be a mix of both. The third digit can be any one of the three

analyses. For example, the combination 411 is valid and corresponds to medium vs short time in small space with temporal analysis, but a combination 323 is invalid.

Of the 36 combinations above and below the central line, note that only 24 are valid. Twelve are invalid and produce scores equal to zero because in effect a hierarchy is being compared with itself. These combinations are :

141	151	241	251	341	351
412	512	422	522	432	532

If the combination 141 was entered the pairing would be short time, medium space, temporal analysis compared with short time, small space, temporal analysis. The different dimension of the space components is not taken into account because analysis is temporal. In effect the pairing is short time, temporal analysis compared with short time, temporal analysis and therefore shows no component shifts and every component's score = 0.

When a valid hierarchy combination has been entered the number of components to be printed is also entered. No more than five components are allowed, identified by component numbers. If the chosen mode is 'without disturbance' (state 1) and a state 2 component number is entered an error occurs.

When all hierarchy pairs to be printed have been entered, FOCUS calculates scores for all valid pairings whether or not they have been selected for printing. Compilation scores for the selected pairings are then written to the file FOCUS.PRN.

OPTION 6

PRINTING SCORES FOR HIERARCHY PAIRS

Using Option 6 the scores for component shifts are ranked and printouts are created. After selecting the mode, the user is given the choice of displaying the scores on the screen or on paper. **The value of scores may be only experimental, to aid hierarchy interpretation.**

6.1 SCREEN DISPLAY

If display is wanted on the screen a prompt requests the hierarchy combination of the pairing to be displayed in the same manner as in the Option 5. The cumulative scores for the chosen hierarchy pair will then appear on the screen in ranked order. It should be noted that stem subtotals are not included in the screen output due to the limitations of screen size. The next prompt offers a choice between paper output, a display of further scores on the screen, or an exit to the main menu.

6.2 PAPER OUTPUT

Ranked scores are printed to the file FOCUS.PRN. With paper output there is the choice of printing the scores for hierarchy pairs as individual selections or as a complete set (all pair combinations). If individual pairs are chosen the hierarchy combinations must be entered as in the screen output (see Option 5). Note that the possible number of individual combinations (maximum 24) exceeds the number of combinations printed (16) when a complete set is requested. This is because some combinations are repetitive of others. As shown by Option 5 examples, the different dimensions of space components cannot be recognised in temporal-only analyses, and dimensions of time cannot be recognised in spatial-only analyses. Hence repetitive combinations are those that produce identical component scores across all components because their non-recognised dimension is the only combination variable. The combinations are (refer to screen display, Option 5):

Spatial-only analysis			Temporal-only analysis		
142	242	342	411	421	431
152	252	352	511	521	531

The analyses of any one column are identical to the other two, and

combinations of the first column of each three become the default combinations when the complete set is requested. When the choice of individual selections or all combinations has been made, a menu of options is displayed. These options allow some control over the number of components printed in each pairing. For example :

OPTIONS

1. Print all components
2. Nominate the cutoff value of printed scores
3. Nominate number of highest scores to be printed

OPTION> **2**

If option 1 is chosen all components in the given mode are printed with their ranked scores and stem subtotals. If low scores are of no interest, a truncated printout may be adequate. Option 2 of the menu allows the user to choose a value above which scores are to be printed. This value is an absolute value, so that negative scores with greater or equal absolute values will be included. For example, an absolute value of 30 limits printing to all the components with scores >= 30 or <= -30.

The third menu option also deletes low scores of no interest but allows the user to nominate a fixed number of components to be printed for each hierarchy pair. The fixed number refers to the highest scores by rank, based on absolute score values. For example, if the number of component scores to be printed is eight, then those components with the eight highest absolute scores will be printed.

OPTION 7

PRINTING SELECTED GRAPHS

Option 7 uses the scores of the hierarchy pairings calculated in Option 5 to print graphs from which spatial boundaries may be identifiable for individual components. **The value of graphs may be only experimental, to aid hierarchy interpretation.**

As with Options 4-6, the mode of analysis must be designated. There is then a choice to print graphs (to allow the user a visual evaluation of significant graph forms) or to proceed directly to a program evaluation of graphs (Option 8). Note that if graphs are not to be printed, they are still evaluated by Option 8. If printing is requested, there is then a choice of printing graphs for nominated components or for all components. For example :

> Input the numbers of the components you would like printed.
> Type 'IND' to see the index, 'END' to finish or 'ALL' to
> print all graphs.
>
> COMPONENTS> ALL

The response in the example prints the full selection of graphs for the current mode of analysis (state 1 or state 2). If individual components are to be selected, the component numbers should be entered at the 'COMPONENT>' prompt (press <RETURN> between each number). The index can be displayed to see the input modes of components. When all components have been entered, type 'END'. Printouts are written to FOCUS.PRN.

OPTION 8

IDENTIFICATION OF SPATIAL BOUNDARIES

To use this option both Option 5 and Option 7 must have been accessed in the appropriate mode of analysis. This option gives a printout of each component and identifies significant spatial boundaries. **The value of spatial boundaries may be only experimental, to aid hierarchy interpretation.**

The components are listed by hierarchy levels for the selected hierarchy, and the identified boundaries are a conservative listing using the graphical evidence of steps from the plotted gradients. If less conservative boundaries are sought the user can visually evaluate the printed graphs (Option 7) and possibly add further gradient steps to the printed list.

The mode of analysis is first selected and then the hierarchy, as in the printing of hierarchies (Option 4). Then a menu is displayed and the columns of interest are designated for printing. For example :

1. Small-Medium-Large
2. Small
3. Medium
4. Large

Indicate the columns of interest (eg 234 for the last three columns).

OPTION> **1234**

If all observer perspectives are of interest then the above option would be entered (note that each perpective encompasses the same observed range between small and large, but differs in the observer's position within that range). If observation from small space alone is of interest, the above option will contain this information but the menu option 2 (i.e. small) would be entered if other observer perspectives are to be ignored. The menu options 2-4 are based on temporal * spatial analyses while option 1 combines temporal-only and spatial-only analyses. The printout is written to the file FOCUS.PRN.

OPTIONS 9 AND 10

SAVE COMPONENTS AND LOAD COMPONENTS

The facility to save components to a file was referred to in section 2.2.13. Option 9 makes it possible to save components to a file whenever the user is at the main menu.

When components have been saved they can be called into the program again with the Load option (Option 10). Components loaded from a file can be treated in the same way as those entered with the editor (see section 2.4).

OPTION 11

EXIT

Option 11 allows the user to exit from FOCUS. A program exit can be made only from the main menu.

12

GENERAL

12.1 STATUS

To use Options 6, 7 and 8 the scoring of component shifts (Option 5) must have been previously calculated for the mode currently being analysed. To check for the presence of calculated scores, 'STATUS' can be entered at the main menu prompt. For example :

STATUS

	Non-disturbed	Disturbed
Scores	1	0
Spatial boundaries	1	0

The status facility shows on line 1 that state 1 scores ('without disturbance') have been calculated but not state 2 scores. On line 2 the facility shows that the same status exists for graph tests and so currently precludes program identification of spatial boundaries (Option 8) in state 2.

12.2 UNIVERSAL EXIT ('>')

The user can interrupt a current task within any of the Options 1-10 by typing '>'. This command allows an exit from the option and a return to the main menu.

12.3 PRINTOUT 'TASKS'

When paper printout is requested for Options 4-8, the first entry of each selected option is followed by a task definition to facilitate interpretation of output. The working context of the definition is also explained by brief user guidelines.

The printing of task definitions cannot be suppressed and therefore every printout carries its own user prompts.

ACKNOWLEDGEMENTS

The authors wish to thank Drs. Jonet Ward and Alan McKinnon for their help in clarifying the text.

REFERENCES

Allen, T.F.H. and Starr, T.B. (1982) Hierarchy. Perspectives for ecological complexity. University of Chicago Press, Chicago. 310pp.

O'Neill, R.V., DeAngelis, D.L., Waide, J.B. and Allen, T.F.H. (1986) A hierarchy concept of ecosystems. Princeton University Press, Princeton, N.J. 253pp.

Penno, M.R. (unpublished) FOCUS - a computer program for analysing systems. Documentation.

White, E.G. (1988) Working through complex issues - with special reference to environment. Studies in Resource Management, No. 4. Centre for Resource Management, Lincoln College, Canterbury, New Zealand, 57pp.

APPENDIX A

DIAGNOSTICS

1.0 INCORRECT ENTRY TYPE

1.1 A character was entered when a digit should have been. This has caused an internal read error.

2.0 INVALID CHOICE OF INPUT

2.1 The options available at this point are 'D' for disturbed mode, 'N' for non-disturbed mode, and '>' to exit.

2.2 The options are 'S' to display the scores on the screen, 'P' to obtain paper output and '>' to exit.

2.3 An invalid component stem was entered. The valid options are those previously specified in this session or specified in the *** Input Time and Space printout.

2.4 The valid frame sizes are 'S' (small or short), 'M' (medium), and 'L' (large or long).

2.5 Valid frames are 'T' (Time) and 'S' (Space).

2.6 Valid component behaviour symbols are 'N' (non-repeating), 'R' (repeating), and '*' (not applicable). The '*' must be put on the appropriate line or an error will occur.

2.7 The options available are 1, 2, 3, or 4. They can be in any combination. For example 23 specifies columns 2 and 3.

2.8 The options are 'A' to obtain all pairings, 'I' to obtain individual pairings, or '>' to exit.

2.9 The options are 'Y' for yes, 'N' for no, or '>' to exit.

2.10 Incorrect component stems were used. The correct stems are specified in *** Input Time and Space printout. All must be specified.

2.11 The options are :

1. Print worksheet blanks
2. Enter or edit components
3. Print observsation limits and components
4. Print selected hierarchies
5. Calculate component shifts between hierarchies
6. Print ranked scores for hierarchy pairs
7. Print selected graphs
8. Identify spatial boundaries
9. Save component to a file
10. Load components from a file
11. Exit

2.12 The mode types are 'D' for disturbed and ' ' for non-disturbed. A 'G' in the mode position indicates a deleted component. It cannot be entered by the user.

2.13 The options for help can be displayed by typing 'HELP' at the '->' prompt.

3.0 LACK OF INFORMATION FOR THE WANTED OPERATION

3.1 Scores must be created using option 5 in the main menu before this function can be used.

3.2 Surface bondaries must be found before this function can be used.

3.3 No components have been loaded or entered to do the requested operation. Load components using option 10 in the main menu or input new data using option 2.

4.0 COMPONENT ERRORS

4.1 The mode is non-disturbed and a disturbed component was asked for. To get a list of components and their respective modes type 'IND'.

4.2 The component has been deleted.

4.3 This is an invalid component number either because it is less than 0 or greater than the total number of components.

4.4 Too many components were specified when the total number of components is less than 5.

4.5 The component number must have been used before.

5.0 COMBINATION ERRORS

5.1 The combination must have 3 digits. Only the numbers 1, 2, and 3 are allowed. For example 123 or 333.

5.2 To find out why the resultant scores are zero it is necessary to examine the theory. See Option 5 above.

5.3 This combination must have 3 digits. The first and second digits can be 1-5 and the third digit 1-3. However if the first digit is 4 or 5 the second digit must be 1, 2 or 3 and vice versa.

5.4 The valid numbers are 1-4 in any combination. For example 1234 or 234.

6.0 SET MAXIMUM EXCEEDED

6.1 Only a total of 3 pairings are allowed for printouts of individual scores.

6.2 Only a total of 5 component stems is allowed.

6.3 A total of 50 components is allowed. Check that all deleted components have been re-used.

6.4 A total of 5 components is allowed with each pairing for individual scores.

7.0 MISCELLANEOUS

7.1 The file that was specified is not in the default directory.

7.2 The file name that was specified has incorrect syntax.

7.3 The code for each frame should be greater that that of the previous frame. For example: Small 21 Medium 24 Large 26.

7.4 Descriptor numbers range from 0 to 31. An incorrect number was given.

7.5 The absolute score must be greater than 0.

APPENDIX B

FOCUS Worksheet to Identify the Scaling of System Components in Resource Studies.

Steps :
> Select columns of time and space units (see footnotes).
> Nominate units for 3 time frames + 3 space frames
> List system components.
> Encode each component across all 6 frames (1 code per frame).
> Classify components into related groupings (stems).
> Identify components belonging only to the disturbance mode.
> Review previous 4 steps, then transfer input to program FOCUS.

Codes : R = Repeating (over time/space).
N = Non-repeating (over time/space).
* = Not applicable (at given time/space frame).

Modes : blank = Without disturbance
D = With disturbance

PROJECT TITLE _____

Time frame units : short (S) _____ medium (M) _____ long (L) _____

A. Component Periodicity

SHEET No. _

Component No.					1	2	3	4	5	6	7	8	9	0
Behavioural Time *														
Time frame					S M L	S M L	S M L	S M L	S M L	S M L	S M L	S M L	S M L	S M L
0	Not Applicable													
1	1unit	_	1day	1wk 1mo										
2	x1.4	_	1.4	1.4 1.4										
3	x2	_	2	2 2										
4	x3	_	3	3 3										
5	x4	_	4	1mo 4										
6	x6	_	1wk	1.4 6										
7	10	_	1.3	2 9										
8	x1.3	_	2	3 1y										
9	x2	_	3	4 1.5										
10	x3	_	1mo	6 2										
11	x4	_	1.2	9 3										
12	x5	_	2	1y 4										
13	x8	_	3	1.5 6										
14	100	_	4	2 10y										
15	x1.6	_	5	3 x1.3										
16	x2	_	8	4 x2										
17	x3	_	1y	6 x3										
18	x5	_	1.3	10y x4										
19	x7	_	2	x1.3 x6										
20	1000	_	3	x2 x8										
21	x1.4	_	4	x3 100y										
22	x2	_	5	x4 x1.6										
23	x3	_	8	x5 x2										
24	x4	_	10y	x8 x4										
25	x6	_	x1.6	100 x5										
26	10000	_	x2	x1.6 x7										
27	x1.2	_	x3	x2 1000										
28	x1.7	_	x5	x3 x1.4										
29	x2.5	_	x7	x5 x2										
30	x4	_	100y	x7 x3										
31	x5	_	x1.4	1000 x4										

* Listed time measures (4 columns) may be used with the first column only of the listed space measures (sheet B).
EITHER choose one of the four listed column options (all data must be within the chosen range);
OR enter one of the two right-hand columns from sheet B and use for both sheets;
OR substitute alternative measures (see User Manual and Guide).

FOCUS Worksheet to Identify the Scaling of System Components in Resource Studies.

Space frame units : small (S) _____ medium (M) _____ large (L) _____

Component Distribution

ET No. _

Component No.	1	2	3	4	5	6	7	8	9	0	
havioural ace*											
Space frame	S M L	S M L	S M L	S M L	S M L	S M L	S M L	S M L	S M L	S M L	
Not Applicable											
1unit __ 1unit	1unit										
x1.4 __ x1.6	x1.8										
x2 __ x2.5	x3										
x3 __ x4	x6										
x4 __ x6	10										
x6 __ 10	x1.8										
10 __ x1.6	x3										
x1.3 __ x2.5	x6										
x2 __ x4	100										
x3 __ x6	x1.8										
x4 __ 100	x3										
x5 __ x1.6	x6										
x8 __ x2.5	1000										
100 __ x4	x1.8										
x1.6 __ x6	x3										
x2 __ 1000	x6										
x3 __ x1.6	10000										
x5 __ x2.5	x1.8										
x7 __ x4	x3										
1000 __ x6	x6										
x1.4 __ 10000	10**5										
x2 __ x1.6	x1.8										
x3 __ x2.5	x3										
x4 __ x4	x6										
x6 __ x6	10**6										
10000 __ 10**5	x1.8										
x1.2 __ x1.6	x3										
x1.7 __ x2.5	x6										
x2.5 __ x4	10**7										
x4 __ x6	x1.8										
x5 __ 10**6	x3										
Stem + Mode											

Space must be defined by LINEAR dimensions only and the measures must be correctly coupled with the chosen time measures (sheet A).
EITHER choose one of the three listed column options as appropriate to sheet A;
OR substitute alternative measures (see User Manual and Guide).

APPENDIX C

CHOICE OF TIME AND SPACE UNITS

Suggested sets of time and space options are presented, including some not listed on the worksheet. Three sets are decimal and may be applied to both time and space to give spans of 5 x 10^4, 1 x 10^6, and 3 x 10^8 units respectively. These options should be adequate for most FOCUS analyses, and all measures of space can be expressed as decimal, based on LINEAR dimensions. Eight additional sets include alternative non-decimal measures of time over the same three decimal ranges as above. A selected time set (decimal or non-decimal) should only be coupled with a space set of the SAME span, as listed.

The suggested sets are based on 'best fits' between decimal and non-decimal sequences for the units shown. Exact progressions over 31 steps are shown in the left-hand column for each of three x values, using the formula

$$x^y \quad (y = 0,1,2,\ldots,30)$$

Other columns show the 'best fits' across full data spans, and the most suitable choice for a given analysis should be based on the following criteria :

a) the span must be wider than the spread of potential data.
b) the step increments within the chosen span should adequately discriminate between distinctive data (i.e. between component behaviours).

Because it is essential for data analysis that all step increments be standardised by the formula above, criterion b) may on occasions be over-ruled in order to maintain criterion a). This may have little or no detriment to an analysis because the SERIAL couplings of time and space measures can often remain unaffected by approximated levels (rows) of data entry.

Alternative progressions can be calculated if necessary using different values of x.

X = 1.435						
Row	X^y	Decimal	Non-decimal			
1	1	1 unit	1 hour	1 day	1 week	1 month
2	1.435	x1.4	1.4	1.4	1.4	1.4
3	2	x2	2	2	2	2
4	3	x3	3	3	3	3
5	4	x4	4	4	1 month	4
6	6	x6	6	1 week	1.4	6
7	9	10 units	9	1.3	2	9
8	12.5	x1.3	13	2	3	1 year
9	18	x2	18	3	4	1.5
10	26	x3	1 day	1 month	6	2
11	37	x4	1.5	1.2	9	3
12	53	x5	2	2	1 year	4
13	76	x8	3	3	1.5	6
14	109	100 units	5	4	2	10 years
15	157	x1.6	1 week	5	3	x1.3
16	225	x2	1.3	8	4	x2
17	323	x3	2	1 year	6	x3
18	464	x5	3	1.3	10 years	x4
19	666	x7	1 month	2	x1.3	x6
20	955	1000 units	1.3	3	x2	x8
21	1371	x1.4	2	4	x3	100 years
22	1967	x2	3	5	x4	x1.6
23	2823	x3	4	8	x5	x2
24	4051	x4	6	10 years	x8	x4
25	5814	x6	8	x1.6	100 years	x5
26	8343	10 000 units	1 year	x2	x1.6	x7
27	11972	x1.2	1.4	x3	x2	1000 years
28	17179	x1.7	2	x5	x3	x1.4
29	24652	x2.5	3	x7	x5	x2
30	35376	x4	4	100 years	x7	x3
31	50764	x5	6	x1.4	1000 years	x4

X = 1.585

Row	X^y	Decimal	Non-decimal	
1	1	1 unit	1 minute	1 day
2	1.585	x1.6	1.6	1.6
3	3	x2.5	3	3
4	4	x4	4	4
5	6	x6	6	1 week
6	10	10 units	10	1.4
7	16	x1.6	16	2
8	25	x2.5	25	1 month
9	40	x4	40	1.3
10	63	x6	1 hour	2
11	100	100 units	2	3
12	159	x1.6	3	5
13	251	x2.5	4	8
14	398	x4	7	1 year
15	632	x6	10	2
16	1001	1000 units	17	3
17	1587	x1.6	1 day	4
18	2515	x2.5	2	7
19	3986	x4	3	10 years
20	6318	x6	4	x2
21	10013	10 000 units	1 week	x3
22	15871	x1.6	2	x4
23	25156	x2.5	3	x8
24	39872	x4	1 month	100 years
25	63198	x6	1.5	x2
26	100169	10**5 units	2	x3
27	158767	x1.6	4	x4
28	251646	x2.5	6	x7
29	398859	x4	9	1000 years
30	632192	x6	1 year	x2
31	1002024	10**6 units	2	x3

X = 1.780

Row	X^y	Decimal	Non-decimal	
1	1	1 unit	1 second	1 minute
2	1.780	x1.8	1.8	1.8
3	3	x3	3	3
4	6	x6	6	6
5	10	10 units	10	10
6	18	x1.8	18	18
7	32	x3	32	32
8	57	x6	1 minute	1 hour
9	101	100 units	2	2
10	179	x1.8	3	3
11	319	x3	5	5
12	568	x6	9	9
13	1012	1000 units	17	17
14	1801	x1.8	30	1 day
15	3205	x3	1 hour	2
16	5706	x6	2	4
17	10156	10 000 units	3	1 week
18	18078	x1.8	5	2
19	32178	x3	9	1 month
20	57277	x6	16	1.3
21	101953	10**5 units	1 day	2
22	181476	x1.8	2	4
23	323028	x3	4	7
24	574990	x6	1 week	1 year
25	1023481	10**6 units	2	2
26	1821797	x1.8	3	3
27	3242798	x3	1 month	6
28	5772180	x6	2	10 years
29	10274480	10**7 units	4	x2
30	18288574	x1.8	7	x3
31	32553662	x3	1 year	x6